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Broken Hock in the Greyhound: Repair Methods and the Plastic Scaphoid

J. K. BATEMAN

Northaw, Potters Bar, Middlesex

SUMMARY.—The condition of broken hock (fractured scaphoid) in the racing greyhound is described. A description is given of different types of fracture and reasons given for the occurrence. The paper deals mainly with open interference which has for its object the improvement in the alignment and general appearance of the limb following anteromedial collapse of the tarsus. The first acrylic scaphoid replacement operation is described.

Introduction

BROKEN hock in the greyhound has often been described and has been dealt with elsewhere by the author. It is a common condition and it need only be stated here that simple broken hock is merely a fracture of the scaphoid bone which lies on the anteromedial aspect of the tarsus. All greyhound racing tracks in this country are left-handed, *i.e.* the greyhounds run in an anti-clockwise direction, and all fractured scaphoids which occur during racing are in the right tarsus. The first stage is probably a partial scaphoid dislocation.

The accident appears to occur when the following three factors are present:—

1. The greyhound is leading with the right (*i.e.* the outer and wrong) legs and consequently the weight of the body is being pulled to the right, away from the direction of travel.

2. The race demands a sudden change of direction to the left, as for example where a bend is being rounded and the dog seeks to regain his balance.

3. The right hind leg is fully extended and a terrific upward thrust is applied.

Under these circumstances, all at speed, the strain may prove to be disastrous.

Breed Incidence

Although fracture of the scaphoid may occur in any greyhound of either sex and in all different shapes of hind leg, there is no doubt that certain sires, *e.g.* Bah's Choice, himself a dog with a fractured scaphoid, have produced many progeny whose right scaphoids have fractured on the track, and sometimes every member of a litter has been affected. The answer to this state of affairs probably lies in the type of hind leg which is transmitted—the long sloping limb, the heavy musculature and the coarse rounded bone plus the undoubted keenness and pace with which they tend to be endowed. This unfortunate tendency to scaphoid fracture is still apparent in second generations of this breed.

Types of Fracture

Scaphoid bones removed from ex-racing dogs show that whereas left bones are normal, the right scaphoids are almost always severely bruised and discoloured in the anteromedial area. Some have visible cracks across the dorsal articular surface, yet there may have been no history of hock lameness. There is some variation in the amount of damage done to the scaphoid in broken hock. Sometimes—and this is rare—the bone is completely dislocated and no fracture at all has taken place. At times the fracture is of the hair-line variety with no displacement of the fragment and only very slight tearing of the interosseous ligaments. The transverse crack is demonstrable on the lateral view of the radiograph. This usually extends down through the entire depth of the bone though cases have been seen where the crack only affected the upper two-thirds of the scaphoid. Scaphoid fracture is never compound but often comminuted. The usual picture is of fracture and immediate extrusion of anterior fragment(s) of

the bone. These latter lie immediately anterior to the joint and are demonstrable on both lateral and anteroposterior radiographs. In the simplest form of this type there is only one fragment, but more often there are two. These are roughly quadrilateral in shape, $\frac{1}{8}$ inch to $\frac{1}{4}$ inch in thickness and surrounded by torn ligamentous attachments. The fragments of scaphoid, being always the anterior parts, are consequently the parts of greatest depth. Their extrusion means that some degree of collapse must take place in the compound joint. This in turn means that there will be some alteration in the shape of the limb and the pes become bowed, the convexity being lateral, or posterior or both.

Treatment

The usual treatment is external but recent work has been diverted towards open reduction and the use of internal metal and plastic supports.

External Treatment

In simple fracture without displacement little treatment is necessary beyond rest. When bone is displaced the first step is naturally to endeavour to replace the extruded fragments by manipulation. More often than not this only appears to be done, and little success can be claimed. The collapse of the opening and the presence of more than one fragment, plus the ligamentous attachments, render this operation wellnigh impossible. Mostly the fragment(s) will lie flat in front of the joint. Further, if success is attained, it is extremely difficult to keep the returned fragment in position, for at this stage of shock it is not considered advisable to give a general anaesthetic, hence some movement is unavoidable. If the fragments are placed flat against the joint and the limb immobilised, repair will take place and the animal will generally lead a useful if slower, racing life, after a period of approximately 3 months. The compound joint anchyloses and the dog adjusts himself to the action of the simple tibia-astragalus joint.

Immobilisation may be attained (1) by the use of plywood leg-shaped splints fitted bi-laterally from the mid-tibial region to the foot over cotton wool, or (2) a metal splint may be bandaged to the anterior surface of the area, over cotton wool. (3) Plaster of Paris may be applied (a) in a complete cast from the mid-tibial region to mid-metatarsus, or (b) in the form of an incomplete, Cellona, annular band built around the astragalus and compound joint only, pressing close to the fragment but leaving a gap along the line of the recurrent tarsal vein as it crosses the anterior aspect of the joint. The whole is covered with elastic adhesive bandage, the vein then passing freely under the bridge thus formed. This last method is probably the most satisfactory provided 3 days of temporary splinting are first allowed to permit the original diffuse swelling to subside. Whichever method is applied, it is customary to leave in position for three weeks. There are other published and unpublished methods of approach. These depend on an annular ligature passed subcutaneously round the area to exert pressure on the fragment.

1. Open Reduction

Open reduction may be used in three ways:—

1. To replace and fix the main fragment.
2. To reduce exostosis in the healed limb by removing the main fragment and replacing it by a metal wedge.
3. To remove all fragments, and replace with a plastic insert—the acrylic scaphoid.

The simplest form of this method is that by single screw insertion. The greyhound is anaesthetised by pentothal sodium or nembutal. After strict aseptic precautions, shaving, etc., an incision about 2 inches long is made in a vertical direction medial to the recurrent tarsal vein over the scaphoid region. The fragment is located, its edges are trimmed, and it is placed over the scaphoid space whence it came. The limb is extended, a hole is drilled through the middle of the fragment and into the remainder of the bone which is still intact. A $\frac{1}{4}$-inch S.S. screw is then inserted and the whole bone is pulled into place (see Fig. 1). A greyhound so treated did not race fast enough after recovery to be graded.

2. Avoidance of Exostosis

The degree of exostosis in a recovered limb depends mainly on the size of extruded fragments and the position in which they settle. If they are of appreciable size, and immobilisation is carried out, the result is practical but the appearance is ungainly. Efforts have, therefore, been made to continue to have practical results with little if any disfigurement in a badly broken hock. The steps demanded are the removal of the fragment(s) and the bracing up of the scaphoid space until the limb assumes its normal shape. Fig. 2 shows the 3 stages of this operation which was a distinct success. It should be noted that only one fragment—that which causes the unsightly medial exostosis—was removed.

Operation

The animal was anaesthetised with nembutal and the medial tarsal area was shaved and cleaned. A vertical incision 2 inches long was made as before. The fragment was located, dissected out and removed by traction on rat-toothed forceps. A sterile stainless steel metal wedge was inserted into the scaphoid space and screwed into the convenient facet on the medial distal aspect of the astragalus. The wound was sutured by silkworm gut. It was reopened a month later, the metal wedge was removed and the whole wound re-sutured as before. It is extremely difficult to detect a previous fracture in a hock so treated. The wedge or stud consists of a band of stainless steel 25/16 inches long, $\frac{1}{4}$ inch wide, 3/64 inch thick. It is folded on itself at one end in the shape of a square on cross section. The free end is bent towards the "square" in order to provide a lock when placed *in situ* and a hole is drilled in the free end so that a 7/64 inch screw may be inserted for anchorage to the astragalus. This method appears worthy of further application and improvement in that type of fracture where there is reason to believe that half of the scaphoid is still intact, and when the extruded fragment is apparently $\frac{1}{2}$ inch or more in

J. K. BATEMAN.—BROKEN HOCK IN THE GREYHOUND: REPAIR METHODS AND THE PLASTIC SCAPHOID

FIG. 1.—A single S.S. screw fixing the main scaphoid fragment.

ANTERO-POSTERIOR VIEW. LATERAL VIEW.

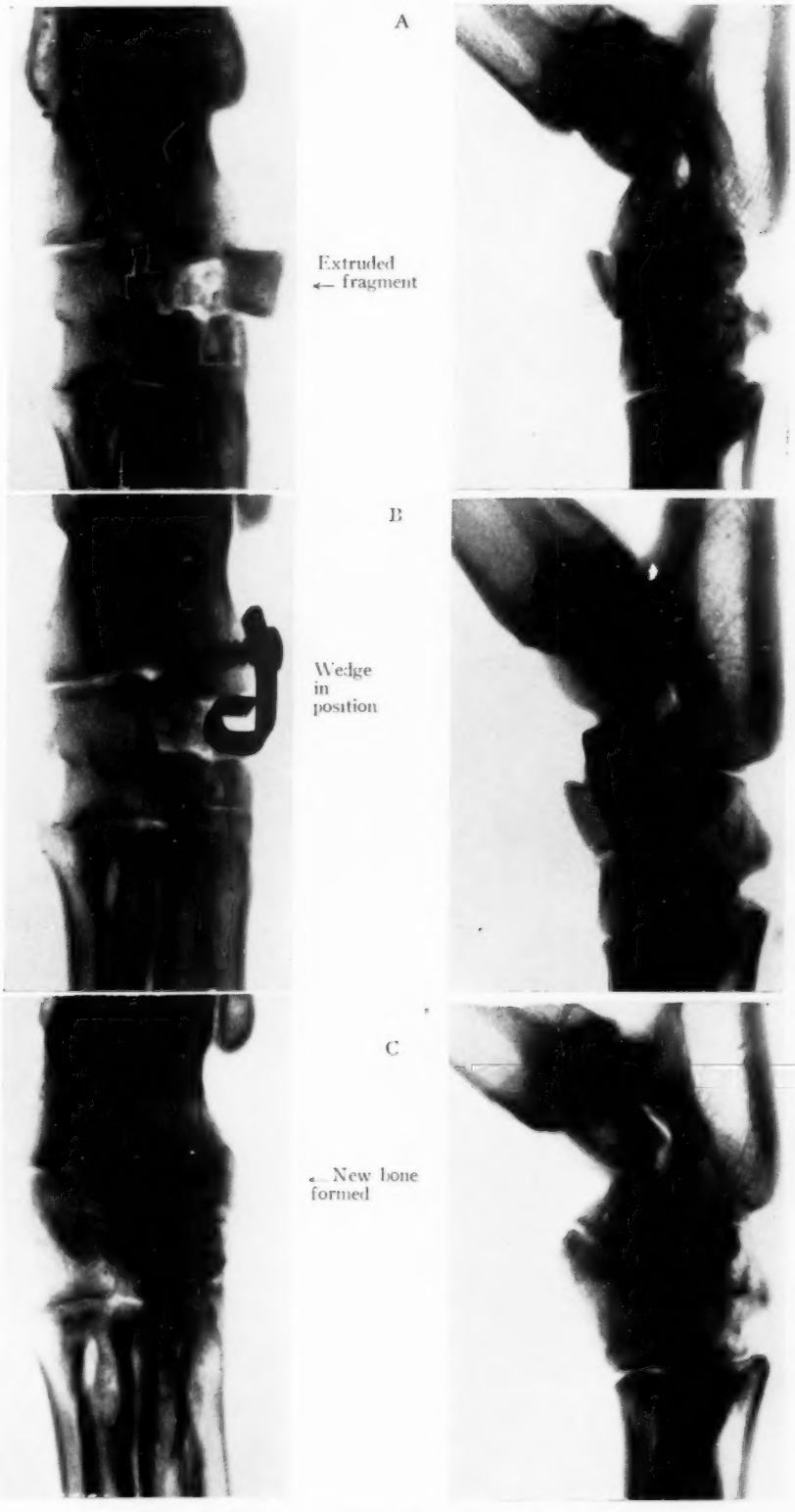
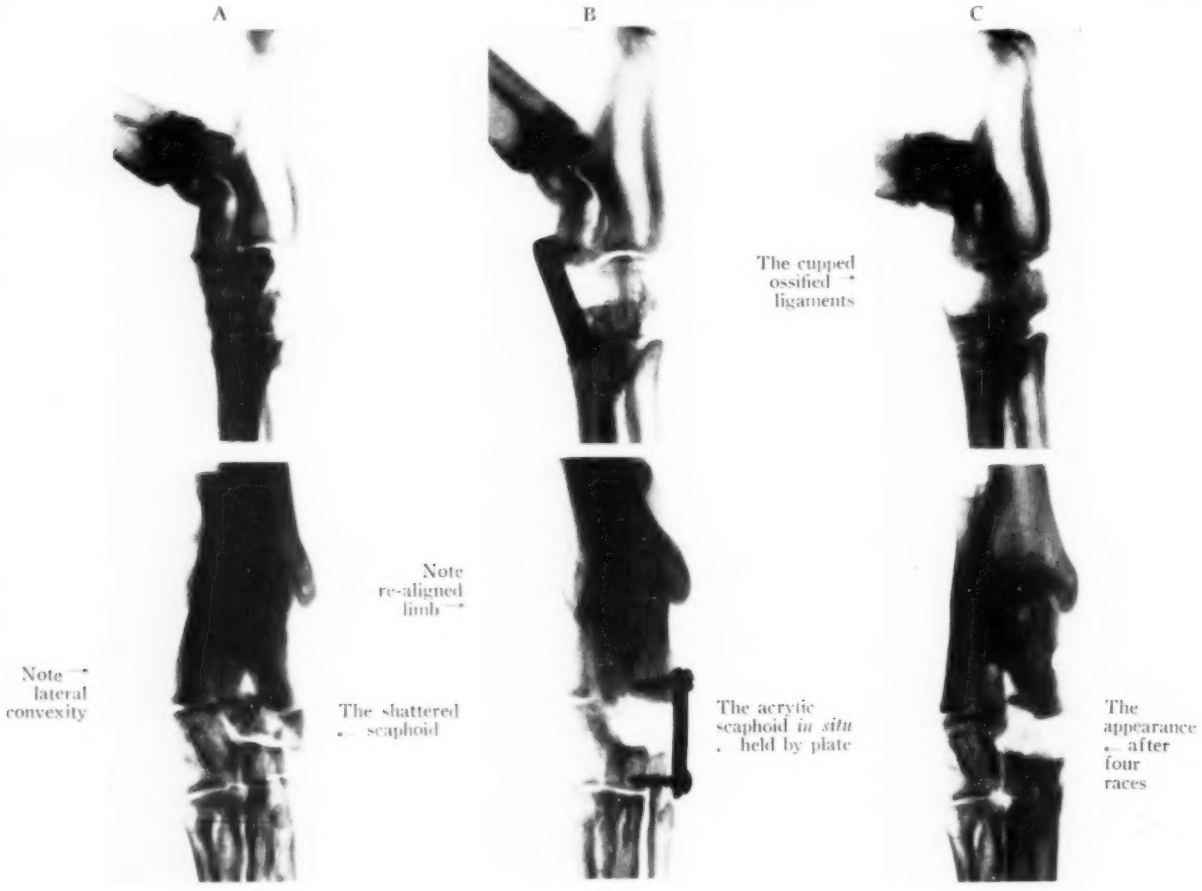


FIG. 2.—Stages in operation for avoidance of exostosis.

FIG. 3.—The plastic (acrylic) scaphoid—"Hare Spy."



A cracked and repaired natural scaphoid.

An acrylic scaphoid.

FIG. 4.

depth. Two greyhound bitches so treated were unfortunately retired for breeding before they could be trained again but both were perfectly sound and the result was most encouraging.

3. The Acrylic Scaphoid

When a scaphoid bone is very badly smashed and deformity is a certainty from the moment of fracture, ordinary methods do not appear to be adequate. The bracing of the collapsed anterior space is also unsatisfactory for it can only allow an abnormal amount of rough new bone to form in the scaphoid space. A plastic (acrylic) insert, moulded to the shape of a normal scaphoid seems to be called for—something which will (1) provide smooth articular surfaces; (2) perhaps retain the mobility of the compound joint; (3) realign the leg to its normal shape and (4) perhaps be more tough than bone (see Fig. 3). A series of different sizes of these acrylic inserts was obtained.

Operation for Inserting Acrylic Scaphoid

Under general anaesthesia a moderate bitch, "Hare Spy," which had badly smashed her right scaphoid, was shaved and prepared for tarsal interference. A 2-inch incision was made as before, in a vertical direction and medial to the recurrent tarsal vein. All extruded fragments were removed, the leg was forcibly extended and all traces of scaphoid bone were removed piecemeal from within the joint. Three acrylic scaphoids were boiled for 10 minutes and, after trying all 3, one was decided upon and slipped into the scaphoid space. The acrylic insert is very slippery to handle and hence is more suitable if it is a very slight degree deeper than the normal bone. In this way it provides a better wedge and is more likely to lock in position. A small metal (S.S.) plate $\frac{1}{4}$ inch wide, 1/32 inch thick and $1\frac{1}{8}$ inch long was bent to follow the contour of the front of the hock. The plate has a single hole at each end. A 7/64-inch screw was driven through the upper hole into the medial surface of the astragalus and another similar anchorage was made into the cuneiform in the lower tarsal row. The wound was sutured with silkworm gut and dressed with Roccal Tincture. A single lateral splint was bandaged on over cotton wool and this was allowed to remain in position for 2 days, after which it was changed daily for a week. The sutures were removed and all external support was taken away.

There was some lameness but the bitch tried to use the limb very soon. Gentle exercise was given and since improvement seemed to have reached a stop at 2 months the wound was re-opened under local anaesthesia and the plate removed. At this stage the acrylic insert which normally is crystal-like in appearance and quite translucent now looked to be a pale purple colour, due doubtless to the adjacent synovial surfaces being seen through it. The wound was re-sutured and healing took place again by first intention. Lameness now practically disappeared but work was interrupted since the bitch came in season. At this stage more freedom to move around was permitted and after her seasonal rest she was

(*Concluded at foot of adjoining column*)

first galloped. There was some slight discomfort but never enough to make the bitch carry the leg.

In 5 months she did her first trial over 500 yards, then after more trials in company with other dogs she went to race and win in her first outing. In 4 months she has run 11 races and 6 trials over 500 yards and won 3 races. So far as is known this is the first time that any animal body has raced with a complete plastic bone replacement. The pre-operation state is shown in Fig. 4a, the immediate post-operation state with the acrylic scaphoid held in position in Fig. 4b, and lastly in Fig. 4c, the appearance of the bones with the bitch in hard work, the insert being retained in position by new bone which has grown along the line of interosseous ligaments. Fig. 4 shows a natural and an acrylic right scaphoid.

Acknowledgments.—I acknowledge the valuable assistance rendered and the radiography carried out by Mr. R. McNair, M.R.C.V.S., and I wish to thank Mr. Laxen of the London Splint Co., for procuring the acrylic scaphoids for me.

My thanks are also due to the G.R.A. Ltd., who have always supported my work with enthusiasm and have readily put injured dogs at my disposal for the furtherance of surgical techniques.

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The Survival of Infectious Canine Hepatitis Virus Under Various Experimental Conditions

BY

L. B. FASTIER

Virus Research Department, Tasman Vaccine Laboratory, Upper Hutt, New Zealand

A COMMON feature of infectious canine hepatitis (Rubarth's disease) is the appearance of sporadic cases within dog populations long after disappearance of signs of the original outbreak (Larin, 1953; Parry & Larin, 1951; Rubarth, 1947). The inability of this disease to be aerially transmitted (Baker *et al.*, 1950), together with its repeated occurrence within establishments in which high standards of hygiene are observed (Parry, 1950), suggest that these continued infections stem from an endogenous source. In this connexion several workers (Parry & Larin, 1951; Baker, Jensen & Witter, 1954; Parry, Larin & Platt, 1951) have reported the continued harbouring and excretion of active virus by dogs following either clinical or subclinical attacks of Rubarth's disease. Contrasting sharply with the acute stage of infection, where most of the body excretions are contagious (Baker, *et al.*, 1954), onset of this carrier condition reduces the transmission medium to urine (Poppensiek & Baker, 1951)—the appearance of virus apparently coinciding with intermittent periods of viraemia (Rubarth, 1952). However, the demonstration of intranuclear inclusion bodies within areas of focal

(*Continued overleaf*)

interstitial nephritis in dogs long after recovery from experimental infection has been interpreted by Poppensiek and Baker (1951) as an indication of active participation of the kidney itself in viral multiplication.

Perpetuation of Rubarth's disease in an establishment appears to be associated with two factors. Firstly, the development of an inapparent carrier state following initial experience with the virus and, secondly, the possibility of prolonged survival of highly infectious virus upon concrete flooring, fomites etc., contaminated by the urine of such dogs. Since a review of the literature failed to disclose data pertinent to this latter aspect a study was undertaken to determine the survival rate under various conditions and the resistance of infectious canine hepatitis virus to certain physical and chemical agents.

Materials and Methods

Virus

The locally-isolated strain of infectious canine hepatitis virus (4737) employed in a previous study (Fastier, 1957) was used. It had been maintained by 10 successive transfers in dog kidney epithelial cells. The pooled infected fluid phases from several large bottle cultures inoculated with passage virus and harvested after 4 days incubation at 36° C. gave a 50 per cent. tissue culture infectivity end point ($TCID_{50}$) of $10^{-6.2}$ when titrated by a conventional *in vitro* procedure (Fastier, 1957). This material was stored with no further treatment in small volumes at −20° C. for use as stock virus in the current experiments.

Tissue Culture Methods

Primary bottle cultures of puppy kidney epithelial cells were established using the standard trypsinisation technique and nutrient medium consisting of Hanks' solution 80 parts; inactivated horse serum 10 parts; 5 per cent. lactalbumin hydrolysate 10 parts, together with 100 units per ml. each of penicillin and streptomycin. When confluent cell sheets were formed secondary bottle or tube cultures were prepared with the aid of 1:2,000 versene solution (Melnick & Opton, 1956). The cells in these subcultures multiplied rapidly and were available for use 36 to 48 hours after preparation.

Detection of viable infectious canine hepatitis virus

The survival time of infectious canine hepatitis virus under different conditions was determined by a single-dilution method. Following the test exposure period virus-containing fluid was diluted 1:10 in nutrient medium and inoculated into at least 4 tubes containing pre-formed kidney cell sheets. After 2 hours' rotation in a conventional roller culture apparatus the fluid phase was completely replaced with fresh medium and incubation continued for 4 days. Obvious cytopathic changes were accepted as an indication of the presence of residual infective virus in the test specimen. The results have been expressed either as the time taken by a specified pnysical agent or as the concentration of a chemical substance required to destroy between 10^4 and 10^5 $TCID_{50}$ virus (the theoretical virus content of the reaction mixture.)

Results

Effect of heat and of ultra-violet light

The stock virus-infected culture fluid was adjusted to *p*H 7.2 with phosphate buffer (0.02M), divided into 4 portions and each diluted with an equal volume of one of the following:—

(a) Phosphate buffered physiological saline (*p*H 7.2).
(b) 80 per cent. suspension (clarified) of normal dog liver.
(c) Normal dog serum.
(d) Seitz-filtered dog urine.

The mixtures were heated in a water bath at 56° C. (± 0.2° C.) and samples removed at 2-minute intervals (up to the 16th minute of heating) and thereafter every 4 minutes. All specimens were immediately diluted 1:10 in chilled culture medium and 0.8 ml. of each inoculated into tubes containing kidney cell sheets.

In the ultra-violet irradiation experiments 15 ml. portions of buffered tissue culture fluid were exposed in shallow dishes 38 cm. below a Westinghouse 782L-30 Sterilamp, the fluids being continuously agitated with a magnetic stirrer. Samples were taken at 2-minute intervals and treated as described above.

TABLE I

INACTIVATION OF INFECTIOUS CANINE HEPATITIS VIRUS BY HEAT AND BY ULTRA-VIOLET LIGHT

Suspensing medium	Treatment	Inactivation time (minutes)
Saline	Heat (56° C.)	10*
40 per cent. dog liver	,,	28
50 per cent. dog serum	,,	14
50 per cent. dog urine	,,	12
Saline...	U.V. light	12

* Time required to inactivate 10^4—10^5 $TCID_{50}$ virus.

The results (Table I) illustrate the increased resistance to heat afforded the virus by high concentrations of liver extract and to a lesser extent by the protein constituents of serum and of urine. In the comparatively protein-deficient mixture composed of culture medium and saline, infectivity was destroyed in 10 minutes at 56° C. Thus the observation of Hodgman and Larin (1953) that infectious canine hepatitis virus in the form of a crude dog liver suspension survived at this temperature for at least 30 minutes could be explained by protective action exerted by host tissue components rather than through any heat-resisting ability inherent in the virus itself.

The virus likewise showed no undue resistance to ultra-violet light, the inactivation time being similar to that required to render non-infectious a strain of human influenza virus (Henle & Henle, 1944).

Survival of infectious canine hepatitis virus at different pH levels

Infected tissue culture material was buffered at 0.02M over a *p*H range of 3.5 to 10.5. The lower

levels were prepared with citric acid-citrate mixtures and the upper with glycine-NaCl-NaOH. The incubation temperature was 20° C. It was found that maximal stability lay in the range of 6.0 to 8.5, infective virus still being recovered from such mixtures up to 3 weeks after preparation (the longest period tested). Between *p*H 3.5 and 5.5 no viable virus could be detected after 10 days, while in the strongly alkaline range (*p*H 9.0 to 10.5) infectivity was destroyed in 5 days.

Survival time of ICH virus upon concrete, sacking etc.

The following experiments were undertaken to determine the survival time of infectious canine hepatitis virus upon materials most likely to be encountered under field conditions. In general plan, samples of soil, sawdust, sacking, concrete and enamelware were artificially contaminated by spreading with a mixture consisting of equal volumes of Seitz-filtered dog urine and stock tissue culture virus. For each sample an inoculum volume of 0.5 ml. was employed, this being adequate to moisten thoroughly without producing surface run-off or excessive percolation. One set of each series was kept wet by periodic spraying with rain-water while the other received no further treatment. All were kept uncovered at room temperature away from direct sunlight. Sampling was accomplished either by shaking (soil, sawdust, sacking) or by swabbing (concrete, enamelware) with 4 ml. nutrient medium and incubation 0.8 ml. of this material, after light centrifugation, into each of 3 dog kidney cell cultures. After 3 hours in the roller culture drum the fluid phases were completely renewed and incubation continued for a total of 4 days. Readings were made in the conventional manner. The specific sizes for each type of specimen were as follows: blocks of soil ($\frac{3}{4}$" square, $\frac{1}{4}$" thick) and dry pine sawdust (250 mg.) were contained within shallow aluminium dishes. A unit area of 1 square inch was employed for heavy sacking, enamel surfaces and well-weathered concrete slabs.

TABLE II
SURVIVAL TIME OF INFECTIOUS CANINE HEPATITIS ON VARIOUS SUBSTANCES UNDER MOIST AND DRY CONDITIONS

Material	Survival time (days)	
	Moist	Dry
Soil	5	3
Sawdust	11	4
Concrete	6	3
Sacking	10	4
Enamelware	ND*	3
Hypodermic needle ...	5 (at 4° C.)	ND
	3 (at 20° C.)	ND

* Not done.

Two features are apparent from the results summarised in Table II. Firstly, that even under conditions more conducive to virus survival than those likely to be experienced in nature, *viz.* absence of direct sunlight, constant temperature, and the absence of gross bacterial contamination, the longest period over which virus survival could be demonstrated was only 11 days. Secondly, rapid destruction of infectivity occurred in the absence of moisture. The indications are, therefore, that infectious canine hepatitis virus does not persist *in vitro* for long periods either upon or within materials most likely to be contaminated by infected excreta.

Survival of ICH virus in hypodermic needles

The natural spread of Rubarth's disease is in all probability by direct contact of dogs with infected material. However, the presence of virus in the blood, constantly during the acute stage of infection and more irregularly in later months (Parry & Larin, 1951; Parry, Larin & Platt, 1951), suggests the possibility that in veterinary practice artificial transmission may occur through use of improperly sterilised instruments, particularly those likely to come in contact with blood or urine. This was tested experimentally by contaminating several 1-inch 20-gauge hypodermic needles by drawing through a mixture consisting of equal volumes of stock infectious canine hepatitis virus suspension and Seitz-filtered dog serum. After draining, the needles were stored in Petri dishes at either room (20° C.) or refrigerator (4° C.) temperature. To determine the presence of viable virus 1 ml. of tissue culture medium was slowly forced through a needle and expelled directly into a tube of dog kidney epithelial cells. Readings were made in the conventional manner after 4 days incubation at 36° C.

The results (Table II) showed that virus could be recovered for 5 days from needles kept at 4° C., whereas it was absent after 3 days from those retained at room temperature. Therefore while it seems probable that the danger of virus communication through the agency of contaminated instruments is more theoretical than real, this method of transmission cannot be entirely ignored. It would thus seem fortunate that, on account of the low heat resistance of infectious canine hepatitis virus, immersion of instruments for a period of 5 to 10 minutes in boiling water provides a practical solution to this problem.

Inactivation of IHC virus by antiseptics

Several common antiseptics were screened for their ability to destroy *in vitro* the infectivity of infectious canine hepatitis virus. Since these virus-antiseptic mixtures would subsequently be inoculated into dog kidney cell cultures to determine the presence or absence of viable virus, a prerequisite to this work was the examination of all substances in their final test concentrations to exclude possible cytotoxic effects. It was found, for example, that certain coal tar products were innocuous for growing cells at a concentration of 0.5 per cent. yet toxic at 0.1 per cent. These compounds were therefore employed at a test concentration of 0.5 per cent., a subsequent 1 : 10 dilution in nutrient medium immediately prior to inoculating kidney cell cultures reducing their activity to subtoxic levels.

All experiments were conducted at room temperature (19° to 22° C.) and were of the general pattern where each antiseptic (in the final concentration

shown in Table III) was incorporated in a mixture consisting of equal volumes of stock virus suspension and Seitz-filtered dog urine. At regular intervals thereafter samples were removed, diluted in nutrient medium and inoculated into tissue culture tubes. All fluid phases were completely renewed 3 hours later and incubation continued for 4 days at 36° C. Cultures inoculated with the test concentration of antiseptic and a saline-urine mixture were routinely included as toxicity controls.

TABLE III
INACTIVATION OF INFECTIOUS CANINE HEPATITIS VIRUS BY ANTISEPTICS

Compound	Working concentration (per cent.)	Inactivation time (hours)
Phenol	0·5	>72
Lysol	0·5	5
Dettol	0·5	>72
Cresol	0·5	>72
Sodium carbonate ...	0·5	5
Formalin	0·1	24
Potassium permanganate	0·1	24
Merthiolate	0·01	5
Mercuric chloride ...	0·1	2
Lugol's iodine	0·1	12

The results (Table III) indicate that for the destruction of infectious canine hepatitis virus lysol was the most effective of antiseptics commonly used in kennel disinfection. Sodium carbonate was also virucidal, its activity presumably being due (as shown earlier) to the adverse effect of an alkaline environment upon virus survival. In several instances, particularly in the case of Lugol's iodine and corrosive sublimate, marked protein precipitation accompanied by virus adsorption appeared to be partly responsible for early loss of infectivity from the test solution. However, since neither substance is extensively used under field conditions, this complicating factor would appear to be more of academic interest than of practical importance.

Discussion

In discussing the natural history of Rubarth's disease Parry and Larin (1951) have suggested that protracted survival of virus outside the dog may contribute towards persistent kennel infection. This hypothesis has not, however, been supported by results obtained from the present experimental approach to the subject. Generally speaking, infectious canine hepatitis virus failed to exhibit any undue resistance towards the inactivating effects of a number of physical and chemical agents when tested under conditions designed to approximate those found in the field. Even in the absence of sunlight and in the presence of moisture (both factors favouring virus survival), the longest periods during which infectivity could be demonstrated in artificially contaminated materials were: sacking (10 days), concrete (6 days), sawdust (11 days), soil (5 days), and enamel surface (3 days). A corresponding series of test samples which were permitted to dry became non-infectious within much shorter time intervals. With some confidence one may therefore conclude that the long-term perpetuation of the disease is related to the *in vivo* carrier state rather than to prolonged survival of virus outside the body.

Studies upon the resistance to heat of infectious canine hepatitis virus have illustrated the influence of the suspending medium composition on virus survival time. Thus the 10 minutes necessary for inactivation of infectivity at 56° C. in a low protein fluid required extension to 12 minutes when carried out in urine, 14 minutes in serum and 28 minutes in high concentrations of dog liver. It appears that the boiling of contaminated instruments, catheters, etc., for 5 to 10 minutes would be adequate for the destruction of this virus. As a practical alternative, their immersion in a 1 to 5 per cent. sodium carbonate solution overnight would achieve the same end result.

The susceptibility of infectious canine hepatitis virus to a number of common antiseptics permits a tentative programme to be suggested for the disinfection of premises recently vacated by dogs suffering from Rubarth's disease. The kennels should be thoroughly sprayed with a 5 per cent. solution of either sodium carbonate or of lysol, particular attention being given to the saturation of sawdust, sacking or other substances used as bedding material. Forty-eight hours later all litter and other disposable items should be removed for incineration and the kennel wet-brushed with fresh disinfectant.

While the above recommendations may result in the rapid destruction of viral infectivity, the continued excretion of this agent both by unrecognised subclinical cases and by inapparent carriers renders virtually impossible the elimination of Rubarth's disease from an establishment by simple chemical disinfection methods. From the long-term viewpoint this appears capable of being achieved only through the maintenance of high antibody levels by artificial immunisation and the immediate use of hyper-immune serum for the passive protection of in-contact animals should clinical cases of the disease reappear.

Conclusion

Experimental studies have shown the virus of infectious canine hepatitis (Rubarth's disease) to be comparatively rapidly inactivated by a number of chemical and physical agents. These observations, together with the limited survival of virus upon various materials commonly found in kennels, suggest that extra-corporeal persistence of virus is not an important factor in the repeated appearance of this disease in dog breeding establishments.

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Refresher Article No. 9

Bovine Piroplasmosis

BY

A. I. WRIGHT

Department of Veterinary Medicine, University of Bristol

AND

M. H. WOODFORD

Dorchester

SUMMARY.—This article is a brief review of bovine piroplasmosis in Britain. After outlining the life history of Babesia bovis, *the protozoan parasite responsible for the disease, and the life history of the arthropod vector* Ixodes ricinus, *the protective mechanisms of premunity and age-resistance are considered as they are directly related to the epidemiology and clinical manifestations of piroplasmosis. The symptoms, diagnosis, treatment, and control are then discussed, together with some observations on several important aspects of the disease which require investigation.*

Introduction

BOVINE piroplasmosis, babesiasis, or redwater fever, is a seasonal, tick-borne disease caused by the multiplication of a protozoan parasite in the red blood corpuscles. Destruction of parasitised erythrocytes and the release of toxins produce the characteristic symptoms of pyrexia, haemoglobinuria, and anaemia. The causal organism responsible for the disease in Britain is *Babesia bovis*, a pathogen restricted to cattle and having a wide distribution in Europe and other temperate regions of the world.

Neitz (1956a) has reviewed the world literature on the piroplasms of domesticated animals and in particular the numerous and complicated classifications of this group. He rightly points out that any scheme of classification is likely to be unstable as so little is known about the life cycles of many of these Protozoa in both their vertebrate and invertebrate hosts. A number of workers have formulated schemes of classification of these piroplasms based on size, morphology, position of the parasite in the red blood cell, geographical distribution, and their reaction to certain drugs. Consequently, a number of genera have been created (*Piroplasma, Babesia, Babesiella, Microbabesia, Nuttalia, Francaiella,* etc.), and these generic names are used to-day in different countries, causing a great deal of confusion. A new and simple classification has been put forward by Neitz; the suborder Piroplasmidea in the order Coccidia of the class Sporozoa is represented by a single family Babesidae with a single genus *Babesia* and a large number of species. The piroplasms which cause theileriasis are placed in a separate suborder Leucosporidea (Neitz & Jansen, 1956) on the grounds that asexual reproduction takes place by schizogony in the leucocytes whereas *Babesia* spp. reproduce by binary fission in the erythrocytes.

The early history of piroplasmosis in Britain is made somewhat obscure by the assumption that the species concerned was the same as that causing piroplasmosis in North America (Texas fever) and South Africa. Stockman (1908) referred to the species responsible for the disease in Britain as *Piroplasma bigeminum* (syn. *Babesia bigemina*) and proved that it could be transmitted from infected to clean stock by blood inoculation. A little later M'Fadyean and Stockman (1911) described a new and smaller species which they called *Piroplasma divergens* (syn. *B. bovis*) and demonstrated that this also could be experimentally transmitted by blood inoculation. In this publication are illustrations of both the large and the small forms of the parasite in erythrocytes of indigenous British cattle.

However, there is now general agreement that *B. bovis* is the only species found in this country to-day and it is doubtful if *B. bigemina* ever did occur naturally although one of its known vectors, *Haemaphysalis cinnabarina* var. *punctata,* is common in parts of Britain. Stockman (1908) showed that this tick could transmit piroplasmosis but it is not clear which species was transmitted in his experiments. The only other piroplasm so far recognised in native British cattle is *Theileria mutans* (syn. *Gonderia mutans*) recently discovered by Hignett (1953), but the extent and significance of infection with this parasite are not known.

The Parasite

B. bovis is best seen in the blood of infected cattle at the height of the stage of fever. Blood smears stained by one of the Romanowsky methods (Leishman or Giemsa) show a variable number of infected red cells, usually about 10 per cent., but as many as 40 per cent. or more may be parasitised. The organisms appear singly or in pairs and although amoeboid and variable in form they are typically pear-shaped bodies which tend to occupy a peripheral position in the red blood corpuscle. When a pair are present, their pointed ends are in contact and their long axes form an obtuse angle (hence the former name *P. divergens*). Rarely more than a pair occupy one red cell. Each individual measures up to 2.0 μ by 1.5 μ and when stained, the cytoplasm appears pale blue with a red chromatin mass extending from which may be a fine string of chromatin granules. The cytoplasm is often vacuolated.

The life history of *B. bovis* in its vertebrate and invertebrate hosts has so far not been elucidated. One of the first theories put forward for the life

history of a *Babesia* spp. was that of Christophers (1907) who studied the development of *B. canis* in the tick *Rhipicephalus sanguineus*. This view is still widely accepted and assumed to be similar for other species but there is by no means universal agreement on the subject. Lapage (1956) discusses the controversy existing at present with regard to the life history of this group, particularly in the invertebrate host. Briefly, it is believed that the trophozoite stage in the erythrocytes of the vertebrate host reproduces by simple binary fission and after destroying the parasitised red cell the products of this multiplication invade other red cells. This stage is unable to develop further unless ingested by an appropriate species of tick. In the tick, multiplication takes place either by a sexual process involving the union of male and female gametocytes to form a zygote followed by sporogony and the formation of motile sporoblasts and sporozoites, or by repeated binary fission without any sexual reproduction. The infective phases which may or may not be sporozoites, find their way to the salivary glands of the tick and pass to the vertebrate host when next the tick feeds. These phases then enter the erythrocytes of the new host to complete the cycle. When an adult female tick becomes infected, the parasite is passed on to the next generation of larval ticks through the eggs.

One of the features of redwater fever is the sudden appearance of large numbers of infected red cells with the onset of symptoms, after an incubation period of 4 to 10 days. Simple binary fission would hardly account for this phenomenon and it is possible that a pre-erythrocyte stage exists as in malaria in which disease large numbers of blood-infecting forms are produced by schizogony in certain fixed tissues of the body during the incubation period. Their simultaneous release into the general circulation closely precedes the onset of symptoms.

The Vector

In Britain the three-host tick *Ixodes ricinus* is the principal invertebrate host for *B. bovis*. *H. cinnabarina* var. *punctata* is another possible vector but piroplasmosis is uncommon in south-east England where this species appears to be most prevalent. *I. ricinus* has a wide distribution in Scotland, Wales, Ireland, and the north and west of England, but redwater fever is frequently absent from tick-infested land. The disease is seasonal and closely related to the seasons of tick activity which vary in different parts of the country. In most districts the main season of activity is from March to July with a peak in April and May. In addition to this so-called spring-feeding strain, an autumn-feeding strain, active from August to November with a peak in September, is present in the west of Scotland and England and also in Wales and Ireland. The two strains are believed not to be interchangeable and where both occur the season of tick activity may be more or less continuous for 7 or 8 months. Outside the recognised tick seasons, odd ticks may occasionally be found feeding on livestock.

The life history of *I. ricinus* occupies 3 years. Eggs laid by adult females develop into larvae which feed the following year and moult to become nymphs. The nymphs feed during their second year of life and moult to become adult males and females which feed and mate in their third year of life. After laying eggs, the adult females, together with the males, then die.

All stages of *I. ricinus* may transmit *B. bovis*. Larvae can inherit the parasite and transmit it to cattle during the larval feed whilst an uninfected larva acquiring infection when it feeds can transmit the disease in the nymphal stage. Similarly, nymphs which pick up infection transmit the disease as adults. If adult ticks become infected when they feed, only the females can pass on the disease by infecting the next generation of larvae. In addition to hereditary and stage-to-stage transmission of piroplasmosis, it is possible that the infection once acquired, may persist not only to the next stage, but through several generations of ticks in the absence of further infection. This has an important bearing on the control of the disease; removal of cattle from an infected pasture for a year of two may not necessarily rid ticks of the parasite.

Each of the three phases in the life history of *I. ricinus* feeds on a different host, a fact which greatly facilitates the spread of tick-borne diseases. During the active season, each stage spends but a few days attached to its host, the time varying with the stage of development. Larvae and nymphs require from 3 to 6 days and adults may take up to a fortnight to engorge. Therefore, in a lifetime of 3 years a total of not much more than 3 weeks is spent taking the annual blood meals. Ticks feed on most domesticated and wild mammals and to some extent birds, but sheep are undoubtedly the most important hosts. It is these features of the life history of *I. ricinus* which make this tick one of the most difficult to eradicate. The biology of *I. ricinus* in Britain has been studied extensively by MacLeod (1932, 1934, 1935, 1936), Lees (1952), Milne (1949, 1950, 1952), and Lees and Milne (1951).

Other Modes of Transmission

Experimentally *B. bovis* can be readily transmitted to susceptible cattle by the parenteral injection of blood taken from an infected animal. So far there is no evidence that the disease is transmitted mechanically by biting arthropods but this possibility cannot be ruled out as similar diseases such as anaplasmosis and certain forms of trypanosomiasis are spread mechanically by biting flies. Intra-uterine transmission has been demonstrated but is thought to be a relatively rare occurrence which probably requires some pathological changes in the placenta. Neitz (1956a, b) reviews the literature on the transmission of the piroplasms and other tick-borne diseases of domesticated animals.

Immunity

It is necessary to consider the immunity developed by cattle to piroplasmosis in order to understand the clinical manifestations of the disease. Recovery from the disease confers a strong resistance or toler-

ance to superinfection. The type of immunity acquired is called premunity, a term denoting a state of resistance which persists as long as small numbers of the infecting organisms remain in the body tissues. It follows that on recovery from the disease animals become symptomless carriers and this may be demonstrated by inoculating a non-infected animal with blood taken from a recently recovered case. Different strains of *Babesia* spp. are known to exist, but there is no real evidence of a multiplicity of strains of *B. bovis* in Britain; nor is there evidence that resistance to one strain will not protect an animal against another strain of the same species. However, there is no cross immunity between different species, for example in countries where both *B. bovis* and *B. bigemina* are endemic, an animal premune to one infection may suffer clinically from the other. The absence of any cross immunity between these two species was demonstrated by Stockman and Wragg (1914).

The duration of premunity in the absence of superinfection is not known with certainty. In general, this protective state tends to wane after 2 years or so unless reinforced by repeated superinfection, as happens in areas where piroplasmosis is endemic. When premunity is lost, the parasite disappears entirely from the body tissues and this may also follow the use of highly efficient drugs during treatment.

The protection afforded by premunity is not absolute for it can break down under the stress of intercurrent disease, long journeys by road and rail, dystocia, and exposure to climatic extremes. For this reason infected cattle may suffer clinical piroplasmosis some time after leaving a redwater district. Experimental splenectomy will precipitate a relapse suggesting that cells of the reticulo-endothelial system prevent an increase in the number of parasites during the state of premunity. In addition to this protective mechanism there is a distinct age-resistance or more correctly, a reverse age-resistance; the younger the animal at the time of initial infection the less severe the symptoms which develop. There is no satisfactory explanation for this phenomenon; resistance probably depends on some basic physiological factor in young animals which disappears on reaching maturity. All young cattle possess this protective mechanism regardless of whether or not their dams are infected.

The clinical manifestations of bovine piroplasmosis therefore vary considerably from one individual to another being dependent on several complex factors. The circumstances in which the disease occurs in the field may be summarised as follows:—

1. As a result of initial infection being acquired when cattle are mature and have lost their innate resistance.
2. When premunity is lost because the infected tick population is too small to ensure regular superinfection, or because therapy results in destruction of all piroplasms in the body.
3. Following a breakdown of premunity precipitated by certain stresses of life which lower the general resistance of the body.

Symptoms

The symptoms of piroplasmosis seen in Britain are fully discussed by Harvey (1935). In calves the disease is very mild; the transient rise in temperature, dullness, and inappetence of a few day's duration are frequently overlooked. Yearlings show a variable degree of diarrhoea and haemoglobinuria and in some districts a severe form of the disease causes fatalities. The commonest syndrome seen in adults may be described as subacute. After an incubation period of about 7 days the onset of symptoms is remarkably sudden; there is a sharp rise in temperature to 106° F. or more accompanied by depression, inappetence, reduction, or cessation of ruminal movements and in milking cows a fall in milk yield. A tendency to separate from the herd and seek seclusion often leads to cases being unobserved by the owner, especially where cattle are not inspected daily. The faeces are ejected with considerable force in a jet, popularly referred to as "pipe-stem diarrhoea," although the faeces may not be diarrhoeic in consistency. Spasm of the anal sphincter is a constant and very characteristic symptom of this disease. The respiration rate is increased and breathing is laboured; the heart rate increases to 100 per minute or more and the pulse is small and weak. Heart beats may be heard from a distance of several yards. Haemoglobinuria develops after a variable period following the first signs of illness. In milking cows where the delay between recognition by the farmer and attendance by a veterinary surgeon is seldom more than 12 hours, haemoglobinuria is often present, but it may be delayed for 24 to 36 hours. The urine appears red to dark brown or almost black in colour and is passed frequently and in small amounts. An abnormally high albumin content causes frothing when the urine strikes the ground and bubbles may persist for several hours. The degree of anaemia is also variable; in extreme cases the blood is thin and watery and may have a red cell count as low as 2,000,000 per cu. mm. of blood and a haemoglobin level of 3 g. or less per 100 ml. of blood. The mucous membranes are pale and icterus develops in the later stages. Animals in late pregnancy may abort. If these cases are treated promptly with specific drugs they usually respond quickly and are well on the way to recovery within 24 hours. When treatment is delayed or has little effect on the course of the disease, as sometimes happens, an obstinate constipation sets in accompanied by severe anaemia and rapid loss of condition. Several days after the onset of symptoms an extremely exhausted animal may die. Constipation, a fall in body temperature to below normal, and the appearance of nervous symptoms such as muscular tremors or aggressiveness in normally docile animals, are unfavourable signs. If the animal survives, complete recovery may take several weeks and in milking cows the loss of milk yield is considerable.

A peracute form of the disease is sometimes seen in adult cattle. The symptoms are similar to those seen initially in the subacute form but more severe, and death can occur within a few hours. There are no reliable figures for the mortality rate from piro-

plasmosis in Britain but it probably does not exceed 5 per cent. of clinical cases, death being attributed to severe anoxia and heart failure.

Post-mortem Appearance

The *post-mortem* appearance of the carcase varies with the duration of illness. Where death occurs in the early stages of the disease the carcase is in good condition, but if death follows an illness of several days' duration the carcase is emaciated, anaemic, jaundiced, and dehydrated in appearance. The liver is enlarged, fatty, and friable with pale yellow streaks and patches on the surface and in the substance. Histologically these lesions are seen to be areas of central lobular necrosis. The spleen is noticeably enlarged and darker than normal when incised. Usually the kidneys show little change apart from congestion of the cortex, but casts of cellular debris, haemoglobin, and haemosiderin are found in the tubules. The bladder contains urine stained by haemoglobin and having a high specific gravity.

Diagnosis

The diagnosis of piroplasmosis is based on the symptoms together with a consideration of the circumstances in which it occurs. In redwater areas it is a common practice to treat all cattle which show pyrexia, inappetence, dullness, and "pipe-stem diarrhoea," as cases of piroplasmosis, even in the absence of the more diagnostic symptoms of haemoglobinuria. This is a wise precaution, for once haemoglobinuria sets in, a massive destruction of erythrocytes has already taken place and it is unfortunate that treatment is often applied too late to prevent this happening. Confirmation of diagnosis can only be made by demonstrating the parasite in a stained smear of peripheral blood, but as the infected erythrocytes may be few in number and their demonstration involves some delay, this important means of diagnosis is somewhat neglected in the field.

Other causes of haemoglobinuria which may be confused with piroplasmosis are poisoning by rape, kale, cabbage and other brassicae; post-parturient haemoglobinuria in eastern parts of Scotland, and the transient and idiopathic haemoglobinuria occasionally seen in calves during the first few weeks of life.

Treatment

Quinuronium sulphate preparations (acaprin)* have been used extensively in Britain for about 25 years, giving such good results that they are still the most popular form of treatment to-day. Acaprin is administered subcutaneously into the dewlap at a dosage rate of 1 ml. of a 5 per cent. solution per 100 lb. bodyweight up to a maximum dose of 6 ml. One therapeutic dose usually suffices to return the temperature and urine to normal within 24 hours provided that treatment is given early in the course of the disease. Some animals show little response to the first injection in which case a second dose should be given 24 hours later. Repeated administration may produce a sensitivity to the drug, and excessively high doses can cause parasitological sterility and a consequent absence of the premunity which normally follows treatment. Harvey (1937) expresses the opinion that since the use of acaprin became general, recurrences of piroplasmosis in treated animals have increased. Toxicity is sometimes seen about 15 minutes after administration of acaprin; animals show restlessness, salivation, and muscular spasms which pass off after a few hours. Occasionally collapse and death may follow a sudden fall in blood pressure and the use of circulatory stimulants such as adrenalin is recommended for these cases.

The only other drug used to any extent in Britain at the moment is an aromatic diamidine known as phenamidine isethionate. This drug is less toxic than acaprin and is administered subcutaneously at a dosage rate of 0.03 ml. of a 40 per cent. solution per kilogram bodyweight.

Mack (1957) has reviewed the extensive Russian literature on the subject of chemotherapy; the urea derivatives haemosporidin and novoplasmin and also the silver compound thiargen are claimed to be effective against piroplasmosis of horses, cattle, and sheep. Ryley (1957) describes experiments with two new compounds† related to acaprin and antrycide respectively. Using *B. rodhaini* infection in mice to screen these drugs they were found to be effective in the treatment of *B. bovis* infection in splenectomised calves, having none of the toxic properties of acaprin.

All cases of piroplasmosis should be regarded as potentially serious until the temperature and urine become normal and the animal commences to eat and pass normal faeces. Good nursing is most important in this disease. The animal is best kept indoors but not if this entails moving it any great distance. One pound of common salt given as a drench or by stomach tube will counteract any tendency to refuse water, and the appetite should be stimulated by providing fresh green food. Blood transfusions are of great benefit when anaemia is severe, followed by parenteral injections of proprietary iron preparations. Ferric and ferrous salts administered orally are contra-indicated owing to their astringent nature.

Control

When non-infected cattle are moved to an area in which piroplasmosis is endemic, a high proportion of cases can be expected to develop and the outcome may involve serious financial loss to the owner. This has happened on many occasions in the past, especially where a farmer has had no experience of the disease, whereas in redwater districts, farmers are usually fully aware of the danger of introducing "clean" animals onto their land. Furthermore, where the disease is endemic, calves should be exposed to tick-infested pastures as soon as possible after birth in order that they may suffer a mild form of the disease followed by premunity.

Apart from these precautions, few attempts have been made in Britain either to control or eradicate bovine piroplasmosis. The economic loss to the country from this disease is difficult to assess as no

* "Acapron" (Bayer), "Babesan" (I.C.I.), "Pirevan" (Evans), "Piroparv" (Burroughs Wellcome).

† Compound 14,911 (I.C.I.) and Compound 10,073 (I.C.I.).

data are available, but it must be of minor importance when considered together with other cattle diseases over the whole country. Nevertheless, financial loss due to piroplasmosis on many farms is sufficient to warrant much more attention to methods of controlling the number of clinical cases, a subject long neglected in this country. In the past 40 years or so our knowledge of this disease in Britain has progressed very little, whereas in some countries piroplasmosis and other tick-borne diseases have been the subject of intensive and fruitful research for many years. Control measures employed abroad have frequently been most rewarding; a notable example of this is the eradication in the U.S.A. of Texas fever, a disease which once threatened the livestock industry of that country. However, a consideration of the methods of control at present available will illustrate the difficulties which would be encountered if these methods were used in Britain.

1. *Eradication of the Tick Vector*

As already explained, the eradication of *I. ricinus* is a formidable problem (Campbell, 1953), and it must be admitted at the outset that the methods available would be too impracticable and expensive if applied in Britain. The most successful method of tick control is the application of acaricides to livestock which will prevent ticks biting or kill ticks as they bite. Many such chemical compounds are known and have been used with good results both in Britain and abroad. They include arsenic, DDT, gamma BHC, and other chlorinated hydrocarbons and many of the newer organic phosphorus compounds. These are applied as dips or sprays, and work is in progress on the parenteral use of some of them. Jolly *et al.* (1953) review the use of acaricides on sheep in Britain, and Heath (1951) has shown that frequent dipping of sheep will clear an area of ticks. However, there is little information about the protection of cattle from *I. ricinus*. Dipping of cattle is not practised here nor is it likely to be, and spraying has so far not become popular with farmers. Downing *et al.* (1952) state that the weekly application of a DDT and BHC mixture to cattle is effective for control, but the expense is too great for general adoption. To achieve complete eradication of ticks, all domesticated stock in an area must receive acaricidal treatment during the season of tick activity and this regimen must be maintained for a number of years, followed by strict isolation to prevent the reintroduction of ticks.

A second method of tick eradication is to make unsuitable the environment in which ticks spend most of their lives. This can be accomplished by ploughing up and reseeding old permanent pastures and draining wet areas of land. Removal of all livestock from tick-infested pastures for a year or two will reduce the number of ticks, but it is doubtful if they would be starved out entirely because some would survive on wild animal hosts. These methods are even less successful than the application of acaricides to stock and considerably more expensive and impracticable to carry out.

Before leaving the subject of control by tick eradication it must be emphasised that unless the methods employed are swift and complete, the results may be disastrous. The success of keeping cattle in areas where piroplasmosis is endemic depends on the early acquisition of infection and premunity to the disease followed by repeated superinfection throughout life in order to maintain and reinforce premunity. Paradoxical though it may seem, a reduction in the number of ticks could lead to an increase in the number of clinical cases of piroplasmosis; cattle would perhaps miss becoming infected as calves and suffer a severe attack when infected as adults, whilst adults already infected would tend to lose their premunity and suffer more than one attack. Even more serious would be the reintroduction of ticks after a period of absence. This applies also to other tick-borne diseases such as tick-borne fever, theileriasis, and anaplasmosis. Pierce (1956) states that in Australia "Graziers are well aware of the dangers of tick fever following a severe reduction in the tick population, and there is little incentive to do more than protect animals from gross tick infestation."

2. *Artificially Induced Premunity*

Artificial premunity has been practised with varying degrees of success for over 50 years in some countries. It is a useful means of protecting "clean" cattle entering a redwater district; of supplementing the premunity of cattle on land where ticks are too few in number to ensure maintenance of premunity; and of protecting calves which are housed during their first year of life.

Carmichael (1956) describes the technique of artificial premunity in general use. Blood is taken from a donor animal which has recovered from an artificially induced infection with a mild strain of the parasite. 1 to 10 c.c. of this blood are injected subcutaneously into the animal to be premunised. This should be carried out at least 3 weeks before exposure to natural infection, and a close watch should be kept on the temperature reaction which occurs about the 8th to the 10th day after injection. If necessary, symptoms should be controlled by specific therapy. Young stock between 3 and 5 months of age are the most suitable subjects; adults may develop severe symptoms of the disease. In Britain artificial premunity has never been widely practised. Many veterinary surgeons have attempted to protect cattle in this way but on the whole the outcome has been disappointing and sometimes fatalities have ensued. It is a pity that accounts of these attempts, whether successful or otherwise, have not been recorded in the literature. In the absence of any information on the control of piroplasmosis by artificial premunity in Britain, it would be unwise to suggest which technique should be employed.

Conclusion

Although research continues in Britain on the chemotherapy of piroplasmosis there is need for a closer study of the epidemiology of this disease, bearing in mind that some of its most important features may be peculiar not only to Britain, but to different parts of Britain. The main points which

require investigation are the life history of *B. bovis*, the degree of infection of tick populations in redwater areas, the duration of infection in generations of ticks in the absence of further infection, the mechanism of age-resistance, the duration of premunity, and the development of a safe and effective method of conferring artificial premunity in the field. Compared with our knowledge of malaria, very little is known about the physiological, biochemical, and pathological changes which occur in piroplasmosis; problems which could be studied in laboratory animals. Moreover, it would be interesting to know the exact relationship between the British strain of *B. bovis* and exotic strains, and between this species and the other small *Babesia* spp. of cattle which occur abroad, such as *B. argentina*, *B. berbera*, and *B. major*. A study of these important problems, so long overdue, would be a useful field of research for we are far from understanding any of them.

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THE ROYAL VETERINARY COLLEGE

The Division of Preventive Medicine will shortly move to the new field station. On and after July 21st, 1958, all blood samples, milk samples, etc., and orders for Mallein should be sent to Hawkshead House, Hawkshead Lane, North Mimms, Hatfield, Herts. The Division will not be able to supply tuberculin after July 31st, 1958.

Potentiation of the Coccidiostatic Effects of Sulphadimidine by Five Different Folic-acid Antagonists

BY

S. B. KENDALL and L. P. JOYNER

Ministry of Agriculture, Fisheries and Food, Central Veterinary Laboratory, Weybridge

SUMMARY.—1. A comparison has been made of the potentiating activity of several compounds of known anti-folic-acid activity on the coccidiostatic effects of sulphadimidine.

2. When given with 0.06 per cent. sulphadimidine in the food, it was estimated that the following concentrations were needed to reduce the mortality due to Eimeria tenella *to less than 10 per cent.*

	per cent.
Proguanil	*0·1*
2:4 diamino 6:7 diisopropyl pteridine	*0·02*
4:6 diamino 1-p. chlorophenyl 1:2 dihydro-2:2 dimethyl 1.3.5 triazine	*0·008*
Pyrimethamine	*0·004*
4:6 diamino 1(3:4 dichlorophenyl) 1:2 dihydro-2:2 dimethyl 1.3.5 triazine	*0·002*

Introduction

RECENT studies have shown that the coccidiostatic effect of sulphadimidine on *Eimeria tenella* is strongly potentiated by pyrimethamine (Joyner & Kendall, 1956a ; Kendall & Joyner, 1956). While exploring the application of this phenomenon, it was decided to examine the effect of replacing the pyrimethamine * by other drugs known to have similar anti-folic-acid activity.

The initial results, which were briefly reported by Joyner and Kendall (1956b), showed that proguanil,† its metabolite 4:6 diamino 1-p chlorophenyl-1:2 dihydro-2:2 dimethyl-1.3.5 triazine (Triazine I), the related 3:4 dichlorophenyl derivative (Triazine II), as well as 2:4 diamino 6:7 diisopropyl pteridine were highly active potentiators.

In order to make a closer comparison of these compounds, a series of experiments was designed to compare their activity under standard conditions when used in combination with 0·06 per cent. sulphadimidine in the food.

Methods

Rhode Island Red or White Leghorn chicks aged 2 to 3 weeks and previously reared in isolation were maintained throughout the experiments in wire-floored, heated hovers and allowed unrestricted food and water. Oocysts of *E. tenella* were given in sufficient numbers to kill the majority of untreated chicks. The drugs were administered for 3 days from the second to the fifth day inclusive, after infection. This period of treatment was chosen because previous work had shown that the main activity of this type of mixture was directed against

*Pyrimethamine—Daraprim, Burroughs, Wellcome & Co.

† Proguanil—Paludrine, Imperial Chemical (Pharmaceuticals) Ltd.

the second generation schizonts (Joyner & Kendall, 1956a), which develop during this period and induce the bleeding which causes the death of the birds.

The experiments were designed to compare the activity of sulphadimidine alone at 3 concentrations, *viz.*, 0·06 per cent., 0·12 per cent. and 0·24 per cent. in the food with that of 0·06 per cent. sulphadimidine, together with each potentiating substance at 3 different concentrations. Previous experience had indicated the concentrations likely to result in therapeutic activity. All drugs were incorporated in a standard chick mash with the aid of a mechanical mixer.

Comparison of Results

The experiments have been recorded in Table I in such a form that the different compounds may be compared as potentiators of the coccidiostatic effects of sulphadimidine. The mortalities obtained in the various groups have been expressed for ease of comparison as percentages of the mortality observed in the relevant groups of untreated birds.

A comparison of the results in columns E and F (Table I) shows that the potentiating substances themselves were ineffective even at the highest concentrations, in preventing deaths from coccidiosis. Mortality did in fact often exceed that observed in the untreated controls. It did not appear that this effect indicated toxicity, mortality in the groups being evidently attributable to caecal coccidiosis. Similarly 0.06 per cent. sulphadimidine (column D 3) possessed very little suppressive effect when used alone. Previous work by Kendall and Joyner (1956) suggested that the ED50 (the dose protecting 50 per cent. of infected chicks) for sulphadimidine was approximately 0·12 per cent. in the food. In the present experiments this value appeared to be slightly less.

Different compounds varied considerably in their ability to potentiate the coccidiostatic activity of 0.06 per cent. sulphadimidine. Proguanil (cols. E 1, 2 & 3) in these experiments exhibited the lowest activity and 4:6 diamino-1 (3:4-dichlorophenyl)- 1·2 dihydro- 2:2 dimethyl-1.3.5 triazine (Triazine II, cols. E 9, 10, 11) in duplicate experiments was 50 times as active.

Pyrimethamine, which has been used extensively in experiments at this laboratory, also showed a high order of activity in duplicate experiments (cols. E 8, 9, 10), 0.004 per cent. giving almost complete control with 0·06 per cent. sulphadimidine. This result was in accordance with the observations reported by by Kendall and Joyner (1956) who found that 0·005 per cent. pyrimethamine was necessary to give control of infection with *E. tenella* when 0·05 per cent. sulphadimidine was used.

The data presented in Table I may be summarised by estimating by inspection the concentrations of the various compounds required with 0·06 per cent. sulphadimidine to reduce the mortality to less than 10 per cent. of the untreated control mortality.

The approximate values so obtained are given below and suggest the following order of activity:—

		per cent.
Proguanil	–	0·1
2:4 diamino 6:7 diisopropyl pteridine	–	0·02
Triazine I	–	0·008
Pyrimethamine	–	0·004
Triazine II	–	0·002

Discussion

All the compounds used in combination with sulphadimidine in the present experiments are believed to interfere with the metabolism of folic acid. This effect has been studied in some detail in the malarial parasite, *Plasmodium gallinaceum* which, like *E. tenella*, parasitises the domestic fowl. Bishop (1954) has recorded the conditions under which the activity of both proguanil and 2:4 diamino 6:7 diisopropyl pteridine against *P. gallinaceum* can be reversed by folic acid, and Rollo (1955) has demonstrated the reversal of the action of pyrimethamine against the same parasite. Similar data for the triazines I and II are not available but a relationship between them and folic acid may be inferred from the demonstration by Crowther and Levi (1953) that the triazine I is the active metabolite of proguanil. This in itself is known to be an antagonist of folic acid.

Potentiation of the activity of a sulphonamide against *P. gallinaceum* by proguanil or pyrimetha-

(*Concluded in col.* 1 *overleaf*)

TABLE I

POTENTIATION OF THE COCCIDIOSTATIC EFFECTS OF SULPHADIMIDINE BY FIVE DIFFERENT FOLIC ACID ANTAGONISTS

Expt. No.	Synergist used	No. chicks per group	No. deaths in untreated control	MORTALITY (per cent. of control)														
				Sulphadimidine alone			0·06% Sulphadimidine + Synergist											Synergist alone at highest concentration
				0·24 %	0·12 %	0·06 %	0·1 %	0·05 %	0·025 %	0·02 %	0·01 %	0·008 %	0·005 %	0·004 %	0·002 %	0·001 %	0·0005 %	
1	2 : 4 diamino 6 : 7 diisopropyl pteridine	14	13	0	65	73·5				8	8		73·5					86
2	Proguanil	20	15	0	7	107	0	13	27									107
3	Triazine I	13	10	0	110	90						10		40	110			130
4	Triazine I	19	10	0	20	60						10		10	30			140
5	Triazine II	22	17	0	6	47									0	12	18	88
6	Triazine II	25	21	0	19	76									0	10	24	110
7	Pyrimethamine	19	14	0	36	107								0	0	21		107
8	Pyrimethamine	22	16	0	6	44								6	25	12		110
				1	2	3	1	2	3	4	5	6	7	8	9	10	11	
	A	B	C		D							E						F

Current Literature

BOOK REVIEWS

The British Pharmacopoeia, 1958. 9th. ed. The Pharmaceutical Press, London. £3 3s.

It is exactly 100 years since the General Medical Council was authorised to publish a Pharmacopoeia, and since then there has been inexorable progress from the galenicals of folk-lore towards highly purified substances. Although a Pharmacopoeia can hardly be considered as romantic literature there will be very few veterinary surgeons, qualified before the 1948 Act, who would not admit to sentimental feelings of nostalgia on reading the changes heralded by the 1958 B.P. The ambiguities of the Imperial system of dosage have almost entirely been replaced by the unequivocal Metric system and Latin names are even further suppressed than in the 1953 B.P. Some 138 monographs have been deleted in this edition, and they include many describing drugs of vegetable origin which contributed quaint Latinisms to the jargon of our student days—pulv rhei co, tinct. digitalis, and quassia amongst them. The deletions include drugs time-honoured in veterinary practice, like carbon tetrachloride, alloin, and oil of chenopodium. There are, too, drugs superseded now after only short official life including sulphathiazole, decamethonium iodide, phenylbutazone, and no fewer than five preparations of penicillin.

Some 60 substances are now recognised for the first time and, with their preparations, account for 160 new monographs. Those with widest appeal to veterinary workers cover the newer antibiotics (18 substances and their preparations) and the corticosteroids (12 monographs), many of which are unlikely to be included in the next British Veterinary Codex. There are new monographs, too, of direct surgical interest, and radioactive preparations receive official status for the first time. The new B.P. is thus a crisp, modern, scientific reference-book both in content and presentation with arrangement, indexing, and type of the highest order. It becomes "official" on September 1st, 1958.

This is the first revision of the B.P. to be published since the impact of the British Veterinary Codex in 1953. It appears that the two publications are by no means mutually exclusive in veterinary medicine. Whilst the B.Vet.C. is of more immediate use in practice its range is considerably restricted to drugs for which veterinary usage is proven. The B.P. is more comprehensive than the B.Vet.C., for instance in providing separate reference for many closely related drugs; in this 1958 edition the number of barbiturates is increased by 3, whilst the antihistamines go up from 2 to 6—drugs being described, whose inclusion in the B. Vet. Codex cannot yet be justified, but for which the veterinary worker may have occasional need. Drugs used successfully in man are inevitably considered for appropriate extension to domesticated animals and in this sense the B.P. 1958 is complementary to the B.Vet.C. and remains an essential requirement of libraries serving the needs of any veterinarian.

The B.P. is purely a book of reference arranged alphabetically, and this function is now facilitated by grouping monographs pharmacologically rather than pharmaceutically so that preparations with the same active drug appear together under that heading. For example, "injection of pethidine" has been renamed "pethidine injection" and appears as alphabetical neighbour to "pethidine tablets" and "pethidine hydrochloride" under P, instead of under I (for injection) as previously. This change has long been overdue from the viewpoint of therapeutics, and it could be even further extended in the next edition. Although dosage recommendations are those of human medicine, a most interesting development is the recognition that the nature of the response may vary with the dose. Thus with stilboestrol three quite separate doses are quoted to produce three different effects.

There are 27 appendices, most of which are of concern only to chemists and pharmacists. Appendix XV, however, gives a valuable 10-page analysis of statistical procedures in bio-assays, of interest to a diversity of laboratory workers.

Potentiation of the Coccidiostatic Effects ect.—*Concluded.*

mine has been demonstrated by Greenberg *et al.* (1948) and Rollo (1955) respectively. The results presented in this paper therefore provide a further demonstration of the similarity between the metabolism of *P. gallinaceum* and *E. tenella*.

The practical application of this phenomenon depends upon a number of considerations. The therapeutic efficiency of these mixtures has been clearly demonstrated, and for short-term administration a suitable mixture could readily be devised. For continuous administration for the prevention of coccidiosis, however, great care must be exercised in the choice of a mixture which would be harmless to the birds. Further study on this aspect is necessary but the demonstration that coccidiostatic effects can be obtained with a wide range of compounds increases the chances of finding a mixture suitable for practical use.

Acknowledgments.—Acknowledgments are due to Imperial Chemical (Pharmaceuticals), Ltd., for supplies of the proguanil and related compounds, to Messrs. Allen & Hanburys, Ltd., for the pteridine compound, and to Messrs. Burroughs, Wellcome & Company for supplies of the pyrimethamine.

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The Vetinfile. Nivek Publications Ltd., London. Price of initial volume £3 3s. Fee for quarterly supplement service £2 2s. per annum.

The review copy of this production does not contain the publishers' name which has been obtained from an advertisement in THE VETERINARY RECORD. There is no indication as to who constitute the Editorial Board mentioned on the fly-leaf of the review copy, and no information is provided as to who may actually be responsible for the individual abstracts which make up the whole production.

There is a general division of the entries into categories headed General Section, Special Section, Horses, Cattle, Pigs, Sheep, Goats, Dogs, and Cats. In each of the sections devoted to a particular species of animal the entries are arranged in the following order: A. Infections caused by micro-organisms; B. Worm infestations; C. Ectoparasitic infestations; D. Metabolic and nutritional disorders; E. Diseases of body organs/systems; F. Reproductive troubles; G. Diseases of new-born animals; H. Surgical diseases and treatment; I. Therapeutics (misc.); J. Other matters.

At first sight the system adopted holds out promise of providing information in a concise and accessible form, but of course the value of the information would depend on two criteria: one, the choice of article to be abstracted, and two, the quality of the abstract. Unfortunately neither of these criteria has been fulfilled. It would appear from the introduction that the Vetinfile is mainly intended for the practitioner. It is easy to decide that it can be of no value to members of the staff of research or teaching institutes. It is therefore proper to explore its possible value to the practitioner. It would seem that its contents are intended for practitioners in the British Isles. A very great proportion of the material referred to in brief in the Vetinfile has appeared in the columns of the regular veterinary periodicals either as original articles or as reviews or abstracts. It is difficult, if not impossible, to find a single entry presenting information that should not already be within the knowledge of a veterinary practitioner who is no more than reasonably up to date. On the other hand some of the entries are not at all informative and would be of little or no help to a practitioner who, as a result of pressure of work, had dropped behind with his reading of veterinary literature. Furthermore the source of the information on which the abstract is given is quite often not provided. Thus the first entry in the General Section refers to a treatment for "Shipping Fever" but gives no indication as to whether the information has been culled from an article in a recognised publication or whether it has been culled from a leaflet put out by the manufacturer of the product named.

It is worth while quoting in full an entry entitled Regional Anaesthesia in Horses which reads: "The regional anatomy of the fore and hind limbs of the horse illustrated by line drawings, forms the subject of an article contributed from the veterinary school of Iowa, by teachers of surgery. The course of the nerves and the technique of their approach and injection are described and details are given of 15 regional nerve blocks carried out with lignocaine or cyclaine." This is undoubtedly an interesting reference but as it stands gives no detail to the practitioner and gives him no indication of how to trace the original article other than by writing direct to the veterinary school of Iowa.

Under the heading of Cattle, Acetonaemia, ketosis, the reader finds in the last paragraph the statement: "The 'Denco' test is described. It consists of a proprietary powder." The original articles appear to be of American origin but no information is given as to who manufactures or markets the proprietary powder for the "Denco" test.

In an interesting entry on products used in the treatment of dogs infested with tapeworms the first two products mentioned are of American origin and are not at present available commercially in Great Britain.

Another difficulty that the practitioner would frequently encounter in using the Vetinfile is that the information culled from an entry is insufficient in itself for him to apply in practice; he would therefore require to obtain the particular publication referred to in order to acquire the requisite details. This he can do—if he so wishes—when the specific reference is given, but in other instances his desire to do so would be frustrated by an absence of data as to where he is to seek the additional details he requires.

Though veterinary periodicals provide an abstract and review service in their columns, and though there are publications that concern themselves solely with the publication of abstracts and reviews, there might be a place in veterinary literature for an additional production furnishing an information service. The best that can be said for the Vetinfile is that it is an endeavour to provide such an additional information service, but it must be admitted that in its present form it is so disappointing and frustrating that it is impossible to commend it.

REPORT

British Empire Cancer Campaign. 35th Annual Report covering the year 1957.

This year, the Report is published in three parts. The first part gives the names of the officers and of members of the executive and scientific committees, and the statements by the Chairman of the Grand Council (the Duke of Devonshire), and of the finance sub-committee (Lord Latham). It is gratifying to note that the Campaign's income in 1957 was a record, amounting to £762,972. The total expenditure on research by the Central Organisation (that is, excluding that by the Autonomous Committees) amounted to £620,723. Has this expenditure been worth while? The impression gained from a perusal of the second part of the Report, which contains the scientific reports of the various organisations and workers supported by the Campaign, is overwhelmingly in favour of an affirmative answer. An enthusiastic and devoted body of research workers is attacking the problem of cancer at all levels and from all directions—cytological, histological, endocrinological, clinical, radiological, therapeutic, and

(*Concluded in col.* 1, *page* 638)

Official Opening of the New Surgery Wing at the University of Bristol Veterinary School

From a Correspondent

THE third main stage in the progressive development of the University of Bristol Veterinary School was officially celebrated on Friday, July 11th, when the Chairman of Council, Sir Wilfrid Anson, High Sheriff of Somersetshire, formally opened the new surgery wing at the Field Station.

Prior to the proceedings at Langford a luncheon was held in Bristol at which the Vice-Chancellor and Lady Morris entertained the Lord Mayor and Sheriff of the City of Bristol, and members of the University Council and Senate. Among the guests were Professor T. J. Bosworth, President of the Royal College of Veterinary Surgeons, and Dr. Thomas Loveday, who had been Vice-Chancellor of the University at the time of the preparation of the reports of the two committees on veterinary education.

The Vice-Chancellor proposed the health of the City of Bristol to which the Lord Mayor replied. Professor C. W. Ottaway, PH.D., F.R.C.V.S., Chairman of the Board of Veterinary Studies, proposed the health of the guests. He referred to the origin of the School in 1948 inaugurated by the Rt. Hon. Tom Williams, then Minister of Agriculture, to the foundation stone laid on that occasion by Dr. Thomas Loveday, and to the fact that when another Minister of Agriculture, the Rt. Hon. Sir Thomas Dugdale, opened the Veterinary Laboratories at Langford in July, 1952, facilities for surgery were still lacking and this was therefore the surgeons' day.

The President of the Royal College replied on behalf of the guests and referred to the enthusiasm which the University of Bristol had always shown for its veterinary School. This, he said, was due in no small measure to the personal qualities of the Vice-Chancellor, Sir Philip Morris, whom the profession were so glad to welcome as an honorary associate of the Royal College.

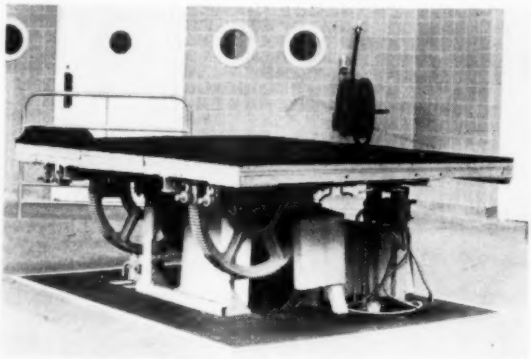
Sir Wilfrid Anson presents the key to Professor Messervy. Included in this photograph are (seated L-R) The Lord Mayor of Bristol, Professor Grunsell, Professor Ottaway, Sir Philip Morris, the Rt. Hon. Lord Sinclair of Cleeve, The Sheriff of Bristol, Mr. Bancroft-Clark, and the President of the Royal College, Professor Bosworth.

The Official Opening Ceremony

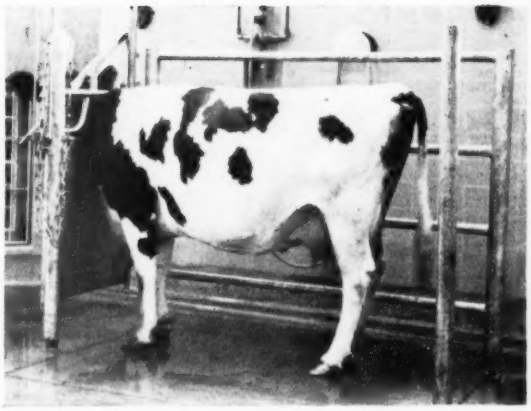
At the afternoon ceremony a notable company was present including representatives from the academic, professional, and agricultural fields. The University of Edinburgh was represented by the Director of Veterinary Studies, Professor Robertson; Cambridge by the Director of Veterinary Clinical Studies, Professor Pugh; London by Professors Amoroso and Formston; and Glasgow by Mr. S. Jennings. Professor Wright from the University of Liverpool was unable to attend. The Registrar of the Royal College of Veterinary Surgeons was also present. The platform party included the Vice-Chancellor, the Chairman of Council, the veterinary professors, the Lord Mayor and Sheriff of Bristol, the President of the R.C.V.S., the Pro-Chancellor, the Rt. Hon. the Lord Sinclair of Cleeve, the Treasurer, Mr. Bancroft-Clark, and the Architect, Mr. R. H. Brentnall.

The Vice-Chancellor, Sir Philip Morris, opened the proceedings and in his speech referred to this further stage in the development of the veterinary School. In introducing the Chairman of Council Sir Philip took the opportunity to express the appreciation of the university for the work which Sir Wilfrid had put in both for veterinary science and for the university in general, and also welcomed the members of the large gathering there assembled.

Sir Wilfrid, in addressing the company, opened with a reference to the programme of expansion in the universities to-day, amongst which increased facilities for training veterinary students to satisfy the country's needs was essential. This need was brought to the attention of those in authority by the Loveday Report, and Sir Wilfrid said how pleased they were to see Dr. Loveday present in person. As a result of that Report the present buildings were envisaged only 10 years ago, and since that time the School had developed into the flourishing centre which could now be seen. The pre-clinical buildings, adjacent to the university in Park Row were finished in 1949, the veterinary medicine wing was opened in July, 1952, and now the veterinary surgery wing was completed. Sir Wilfrid continued: "I would like to pay tribute to the outstanding work of the late Professor Blakemore who as Director here from 1949 had prime responsibility for the developments at Langford until



View of large-animal operating table.



Showing Ayrshire cow in stocks which are used for all standing operations.

his untimely death in 1955 which was a very great blow to the School. Secondly, I should like to express our appreciation of the work that has been done by his colleagues. We recognise all that they have done here and feel sure that the future of the veterinary School is in good hands." In conclusion Sir Wilfrid said," I feel that not only the University of Bristol, but all the veterinary profession can be justly proud of this veterinary School. I have much pleasure in entrusting the key to Professor Messervy."

Professor Messervy's Speech

Professor Messervy, after receiving the key, thanked Sir Wilfrid Anson for all he had said about the School. He then made further reference to the contribution Dr. Loveday had made to the veterinary profession, which, Professor Messervy said, might not be fully recognised for 20 years. The Professor continued: "In Bristol the academic foundation stone was laid by Professor Blakemore, who, until his death three years ago, directed this School and now it is left to us to cultivate this fertile soil which he had well and truly ploughed with a straight furrow." Having expressed the pleasure shared by the company that Mrs. Blakemore was able to attend the ceremony, he continued: "Langford, established as a field station primarily for the study of veterinary medicine and surgery by final year students, has grown far bigger than this term would imply. The situation at Langford is unique as far as I am aware. As well as the University, there is the Ministry of Agriculture Veterinary Investigation Centre, and the Artificial Insemination Centre of Messrs. Horlicks whose members of staff are part-time lecturers. The surgery wing does not complete our requirements here, as it hoped to see further additions, particularly in the Department of animal husbandry."

Having paid tribute to the architect, to Dr. Wynne Jones, to the late Miss Levie, Mr. Alexander, and others who had borne their part in bringing the new wing into physical being, Professor Messervy concluded by saying: "So far as I am aware, Bristol is

(*Concluded in col.* 1, *page* 638)

News and Comment

THE WORTLEY AXE TRUST

Under the provisions of this Trust, which the Council of the Victoria Veterinary Benevolent Fund wishes to implement, one or two cottages or bungalows may be built in which beneficiaries of the Trust would live rent free. As with the Fund's other activities, it is the intention to offer help to veterinary surgeons, or their dependents, who may be in need.

It is not easy to decide to what extent such accommodation is called for, and it is at the request of the Council of the Fund that we publish this note inviting members of the profession to express an opinion. In various parts of the country it well may be that readers of this journal have confidential knowledge which would assist the Council in their consideration of this matter. If they would be good enough to write to the secretary of the Fund, at 10, Red Lion Square, London, W.C.1, there would be no need either to mention names, nor even to give such specific information as might be a breach of confidence; but advice to the effect that a veterinary surgeon had knowledge of one, or more, persons or families whose lot would be notably eased by the provision of rent-free accommodation could help a great deal.

None of us is immune from the mischances of life, and indigence in old age, or through ill health, may be the lot of those who least deserve such tribulations. In such cases it is not difficult to appreciate that the provision of a home, carrying with it that privacy and independence which mean so much, could mean the difference between night and day.

The Council of the Fund, in their wish to carry the Wortley Axe bequest into practical effect, have in mind what well may be a service to the profession as necessary as it is valuable. We hope our readers will assist as much as may lie in their power to provide evidence upon which the Council can decide upon its future action in this matter.

Current Literature—*Concluded.*

other disciplines are all playing their part, and it seems certain that cancer must, within a measurable time, yield up its secrets to such relentless probings.

It would not be possible here to do more than refer to a very few of the many projects reported, and the Report should be read in the original by all those who would know what is being done. It must, however, be regretfully repeated, as in our review of the previous Report, that there is no subject index—an astounding and almost incredible deficiency.

The third part of the Report consists of Dr. Percy Stock's masterly and somewhat disturbing survey of some geographical, environmental, and social factors that appear to be associated with the incidence of cancer in North Wales, the Liverpool region, and the Isle of Man. This has already been commented on in the daily press, but it is well worth reading in the original.

There is no doubt that the B.E.C.C. deserves the generous support of us all. The day is approaching when cancer will be conquered, and the B.E.C.C. will have played a most honourable part in the victory.

Official Opening of the New Surgery Wing—*Concluded.*

the only university whose Chancellor and Vice-Chancellor are veterinary surgeons. There are two ways of becoming a veterinary surgeon. One is to work hard at school, matriculate for entry into university, and undergo a rigorous 5 years before graduation. The other is to build your own school, and the Council of the Royal College of Veterinary Surgeons, in their wisdom, will invite you to accept membership. This membership carries with it the same responsibilities as attach to the graduate, and therefore, Mr. Vice-Chancellor, it is with great pleasure that I invite you to reside at Langford where a room has been reserved in order to study the art and science of your new profession."

Professor Messervy then opened the door to the new wing and invited Sir Wilfrid Anson to precede him into the building. The main doors were next opened, and the platform party and their ladies commenced the tour of inspection. The remainder of the guests were then able to inspect both the new wing and other departments of the field station where exhibits had been prepared.

VETERINARIAN POETS

"Poetry's unnat'ral," said the elder Mr. Weller; "no man ever talked poetry 'cept a beadle on Boxin' Day, or Warren's blackin', or Rowland's oil, or some o' them low fellows. Never let yourself down to talk poetry, my boy." Yet notwithstanding this advice from one of the wisest of men, there are veterinary surgeons who express themselves to us in verse.

It is to these gentlemen (for as yet no Sappho has appeared from among the ranks of lady veterinarians) that this note is addressed. They must have wondered whether it was deafness to their muse, indifference to art in general, or just churlishness which had led to the non-publication of their offerings. It was not so much these things as that sedateness of mind proper to the management of a scientific professional journal. For the veterinarian, so far as we have evidence upon which to judge, is a comic poet. His association with nature seems to excite not the rapture of Wordsworth but the glee of Thomas Hood; and those softening influences to which he might be thought to be exposed, while passing like Shakespeare's sprite "over hill over dale through bush and through briar" (to say nothing of through midden and through sty) would seem to be wholly lost upon him.

True, there was something not unpleasing about a student's couplet which ran,

Why ask for prognosis
Where only God knowsis?

but we suspect that the higher poetic flights fail to be offered to us out of modesty. Should that be so, let these shrinking violets "come forth, suffer themselves to be admired and not blush so."

It was necessary, not long ago, to reject—not without regret—the suggestion of two students that these pages would be better for the occasional trespass upon them of nubile young women; but a poetic supplement, from time to time, would add to this journal a lustre and refinement enough to make it the envy of every contemporary.

WORLD POULTRY CONGRESS

Her Majesty's Government has accepted an invitation from the Mexican Government to send a delegation from the United Kingdom to the 11th World Poultry Congress which is being held in Mexico City in September, 1958.

Dr. Alan Greenwood, Director of the Agricultural Research Council's Poultry Research Centre, Edinburgh, will be the leader of the delegation. The other members are:—

Dr. J. E. Wilson, Senior Research Officer in charge of the Veterinary Laboratory of the Ministry of Agriculture at Lasswade, Midlothian; Dr. R. Coles, Chief Poultry Advisory Officer, Ministry of Agriculture; Mr. M. C. Morgan, N.D.P., Director of the Wheaton Aston Poultry Progeny Testing Station of the Ministry of Agriculture; Mr. J. Getty, Senior Poultry Inspector of the Department of Agriculture for Scotland; Mr. H. I. Clarke, Poultry Officer, Ministry of Agriculture and Lands, Jamaica; Mr. E. T. Halnan, formerly of the School of Agriculture, Cambridge; Mr. William Buchanan, Mr. F. Cumber, Mr. Antony G. A. Fisher, Major Ian Macdougall, O.B.E., Dr. W. M. McKay, PH.D., M.R.C.V.S., and Mr. Harry W. Melville, representatives of the British National Committee of the 11th World Poultry Congress.

THE COLONIAL VETERINARY SERVICE

Promotion. D. K. Jawara, M.R.C.V.S., D.T.V.M., Veterinary Officer, Gambia, becomes Principal Veterinary Officer, Gambia.

New appointments. D. Gosden, Laboratory Technician, Veterinary Department, Kenya; R. M. McCaughey, M.R.C.V.S. (DUBLIN), Veterinary Officer, Tanganyika.

THE REGISTER OF VETERINARY SURGEONS

The names of the undermentioned gentlemen were restored to the Register of Veterinary Surgeons under the provisions of Section 17 (2) of the Veterinary Surgeons Act, 1948, on the dates indicated:—

CRAWFORD, Thomas Gibson, Hobbles Green Farm, Cowlinge, Nr. Newmarket, Suffolk, July 24th, 1958; JOHNSTON, Thomas Ernest, Main Street, Fintona, Co. Tyrone, July 24th, 1958.

UNIVERSITY NEWS

London

B.VET.MED. VETERINARY CLINICAL EXAMINATION

Part I

Challis, David John; Clemenger, John Frederick Parsons; Cleverly, John Malcolm; De Vile, Christopher Paul; Entwisle, John Malcolm; Gibbons, Janet Elaine; Green, Roger; Hazzard, Terence Cuthbert; Humphreys, Gerald Usmar; Lorenzen, Charles Christopher Martin; Lorenzen, Patricia Jean; Pabs-Garnon, Leonard Fredrick; Redfern, David Michael; Rohrbach, John Alexander; Sheridan, John Phillip; Shields, Rodney Aldred Somerset; Smith, John Stroyan; Stock, John Edward; and Stockley, Rachel Elizabeth.

PRE-CLINICAL EXAMINATION

Part II

Auckland, Bryan Edward; Ball, Frederick Charles; Buckle, Pryce Urban; Denly, Ian Winter; Flint, Peter Anthony; Foord, Henry Edward; Goldring, Susan Patricia; Johnstone, Michael William; Lonnon, Peter Howard; Mann, Christopher James; Rees, Dan Edward Gareth; Robins, David Hilton; Unwin, David Dudley; Ward, Derek Kimberley Peter; Willott, John Arthur; and Wilson, Robin William.

R.C.V.S. OBITUARY

We record with regret the deaths of the following members of the profession:—

TAPLEY, James John Bonifant, C.B., D.S.O., The Gate House, St. Stephens Road, Bournemouth, Hants., Major-General, late Director-General A.V.S. Graduated July 13th, 1899, at the Royal Veterinary College, London. Died July 17th, 1958, aged 80 years.

HINES, Arthur James, 38, College Street, Grimsby, Lincs., Captain R.A.V.C. (T.A.) (Retd.). Graduated September 13th, 1897, at the Royal Veterinary College, London. Died July 24th, 1958, aged 81 years.

PERSONAL

Mr. F. G. Brown will be leaving shortly on a month's visit to the United States. He will represent the British Veterinary Association at the Annual Convention of the American Veterinary Medical Association in Philadelphia. During his visit Mr. Brown will be conferring with veterinarians and other research scientists on the development of new veterinary products, and he will meet many poultry experts at the Poultry Science Association Meeting at Cornell University. He is veterinary adviser to Smith, Kline and French Laboratories Ltd.

Mr. J. E. Wilson has been awarded the doctorate of Veterinary Medicine and Surgery by the University of Edinburgh.

Births

LEACH.—On July 10th, 1958, to Jean, wife of John Leach, B.SC., M.R.C.V.S., of 371, Hagley Road, Edgbaston, Birmingham, 17, a daughter, Jane Colleen, sister for Belinda and Richard.

LESTER.—On July 11th, 1958, to Joyce, wife of W. Antony Lester, B.V.SC., M.R.C.V.S., of Stoke Road, Beaminster, Dorset, a daughter, Victoria Mary.

PETERS.—On July 5th, 1958, at Nakasero Hospital, Kampala, Uganda, to Pamela, wife of John Peters, M.R.C.V.S., of the Dept. of Veterinary Services, Karamoya, a son—a brother for Mark.

ROULSTON.—On July 12th, 1958, at Ankara, Turkey, to Edith (*née* Lyon), M.R.C.V.S., wife of Tom Roulston, a son, David John.

WHITTLESTONE.—On July 12th, 1958, to Inga, wife of Peter Whittlestone, M.A., PH.D., B.SC., M.R.C.V.S., a daughter, Ann.

Engagement

SYKES—WARREN.—The engagement is announced between Kenneth Chadwick Sykes, B.VET.MED., M.R.C.V.S., only son of Mr. and Mrs. W. Sykes of Leigh, Lancs., and Brenda Warren, eldest daughter of Mr. and Mrs. E. C. Warren, of Stapleton, Bristol.

Marriages

WILSON—SAPTE.—On Saturday, July 26th, 1958, at St. Andrew's Church, Watford, Robert Malcolm Wilson, M.R.C.V.S., of Oxted, Surrey, to Sheila Antoinette Sapte, B.A., VET.M.B., M.R.C.V.S., of Watford.

EVANS—CHAMBERLAIN.—On July 30th, 1958, at Stanford-on-Soar, Richard Keith Evans, B.V.SC., M.R.C.V.S., of Harworth, Doncaster, to Jean Eileen Chamberlain of Quorn, Leics.

COMING EVENTS

September

17th (Wed.). Meeting of the North Wales Division at Glynllifon, Caernarvon.

21st to 26th (Official Opening, Monday, September 22nd). 76th Annual Congress of the British Veterinary Association in Douglas, Isle of Man.

ADDRESSES OF DISEASE INFECTED PREMISES

The list given below indicates, first the county in which are situated the premises on which disease has been confirmed, followed by the postal address and date of outbreak.

Anthrax

Lanarks. East Hookhead Farm, Strathaven (July 22).
Suffolk. Place Farm, Glemsford, Sudbury (July 23).
Wigtown. Craig Croft, Whithorn, Newton Stewart (July 18).
Yorks. Croxby Hall Farm, Huil Road, Cottingham (July 21).

Fowl Pest

Cambs. Black Jack, London Road, Chatteris; 69, The Avenue, March (July 18); 8, Second Drove, Little Downham, Ely (July 19); 3, Town End Pits Lane, March (July 22).
Essex. Frog Hall, Lambourne Road, Chigwell Row, Chigwell (July 22).
Herts. 4, Swans Car Park Nursery, Waltham Cross (July 23).
Middx. Green Acre Farm, Bedfont Road, Stanwell, Staines (July 22).
Norfolk. Park Farm, Deopham, Wymondham; Hillcrest Farm, Wretton, King's Lynn (July 19); Ivy Cottage, Hevingham, Norwich (July 23); Premises rear of The Stores, High Street, Stoke Ferry, King's Lynn (July 23); Whitehouse, Hackford, Wymondham; Gravel Pit Fields, Hall Lane, Hackford, Wymondham; Pear Tree House, Park Lane, Deopham, Wymondham; Cooks Farm, Suffield, Norwich (July 24).
Sussex. Little Funnells Farm, Maynards Green, Horam (July 18); Hendalls Farm, Maynards Green, Horam; Bolney Farm, Hailsham (July 24).

Swine Fever

Bucks. Deanfield Nursery, Saunderton, Princes Risborough (July 22); The Piggeries, The Green Chalvey, Slough (July 24).
Caerns. Pen yr Allt Farm, Nant-y-Gamar, Craigydon, Llandudno (July 23).
Cambs. The Bungalow, Wardy Hill, Ely (July 18).
Denbigh. Old Llyn Onn Farm, Adenbury, Wrexham (July 18).
Essex. Spains Hall, Willingale, Ongar (July 21).
Glouc.s. Feltham Farm, Pucklechurch, Bristol (July 21).
Leics. 34, School Lane, Woodhouse (July 18); Marlow Road Allotment, Narborough Road (July 21).
Norfolk. Castle Farm, Hoxne, Diss (July 18); Gt. Watts Field, Hevingham, Norwich; Brickiln Farm, Banningham, Norwich (July 21); Dairy Farm, Rushford, Thetford (July 22).
Northants. Smiths Buildings, Weedon (July 23).
Slrops. Fir Tree Farm, Wentnor, Bishops Castle (July 22); The Springs, Ellesmere (July 23).
Suffolk. Elm Farm, Gt. Barton, Bury St. Edmunds; Mayhews Farm, Battisford, Ipswich (July 21); Hall Farm, Walsham Le Willows, Bury St. Edmunds (July 22); Pound Farm, Oulton, Lowestoft; Rose Farm, Battisford, Stowmarket (July 24).
Warwicks. Ireland Farm, Gaydon (July 21).
Wilts. Quobbs Farm, Mile Elm, Calne (July 18).
Yorks. The Poultry Farm, Bogs Lane, Harrogate (July 21); High Barn, Sharrow, Ripon; Low Barn, Sharrow, Ripon; Blois Hall, Copt Hewick, Ripon (July 24).

ENDING OF THE GIN TRAP

At a demonstration of approved traps held on July 30th, Earl Waldegrave, Joint Parliamentary Secretary to the Ministry of Agriculture, said: "July 31st is an important date for all those who want to see cruelty to animals reduced. This is because after to-morrow only spring traps approved by the Minister of Agriculture may be used for trapping animals in England and Wales. The gin trap—which the Committee on Cruelty to Wild Animals described as 'a diabolical instrument'—has *not* been approved and it will therefore be illegal to use it in future for any purpose.

"This humanitarian step marks the end of a long fight to ban the use of cruel traps, which culminated in Parliament with the passage of the Pests Act, 1954. The years since then have been devoted to finding humane and efficient traps to replace the gin. The traps you will see to-day were recommended by this Committee and have been approved by the Minister. They are designed to kill instantaneously and humanely and will be available for use where trapping is considered necessary. But of course trapping is not the only way of getting rid of rabbits and many people think that gassing and shooting achieve more effective results.

"The Humane Traps Advisory Committee examined about 200 traps and the seven exhibited to-day were chosen after extensive field trials. Three of the traps, the Imbra Mark I, the Imbra Mark II, and the Juby, are designed to catch and kill rabbits in their holes. In the field trials, about 90 per cent. of the rabbits caught by these traps were killed outright. These traps can also be used successfully in artificial tunnels against ground vermin.

"The Fenn Vermin Trap, as its name implies, was specially designed for use against ground vermin, mainly in artificial tunnels. In the field trials it caught and killed outright grey squirrels, stoats, weasels, and rats. It is a good trap for rats."

ADVERTISER'S ANNOUNCEMENT

THE DISTILLERS COMPANY (BIOCHEMICALS) LIMITED announces a reduction in their prices for "Distaquaine" V Sulpha Tablets effective from Monday, August 11th, 1958. The new prices can be obtained from the Veterinary Department, The Distillers Company (Biochemicals) Limited, Broadway House, The Broadway, Wimbledon, London, S.W.19. Telephone: Liberty 6600.